We claim:

1. A method of calibrating a pump having a motor, the pump connected to a water distribution system, the method comprising:

operating the motor in a forward direction;

sensing a pressure in the water distribution system;

determining whether the sensed pressure has increased by a pressure increment;

increasing an operating frequency of the motor by a frequency increment if the sensed pressure has not increased by the pressure increment; and

storing a speed of the motor as a minimum calibrated speed value if the sensed pressure has increased by the pressure increment.

2. The method of claim 1 and further comprising reducing the speed of the motor by at least one frequency increment before storing the speed of the motor as the minimum calibrated speed value.

3. The method of claim 1 and further comprising sensing a pressure between the pump and a water tank.

4. The method of claim 1 and further comprising determining whether the sensed pressure has increased by a pressure increment of one pound per square inch and increasing an operating frequency of the motor by a frequency increment of one Hertz.

5. The method of claim 1 and further comprising setting at least one gain based on the minimum calibrated speed value.

6. The method of claim 1 and further comprising sensing a pressure in a water distribution system connected to at least one of a well pump system, a municipal water system, a pool system, a spa system, a recreational vehicle water system, a marine craft water system, a turf or irrigation system, and a pressure boost system.

7. The method of claim 1 and further comprising performing a regulation mode to increase the pressure in a water tank to a tank pressure setpoint and performing a search mode to increase the pressure in the water tank to a pressure increment above the tank pressure setpoint.

8. The method of claim 1 and further comprising setting a gain for a proportional/integral control loop based on the minimum calibrated speed value.

9. A method of regulating a speed of a motor in a pump, the pump connected to a water distribution system, the method comprising:

measuring an actual pressure in the water distribution system;

determining whether the actual pressure is less than, greater than, or equal to a constant pressure setpoint;

subtracting the actual pressure from a desired pressure to determine a pressure error if the actual pressure is less than or greater than the constant pressure setpoint;

determining an integral of the pressure error;

multiplying the integral by an integral gain to determine a first value;

multiplying the pressure error by a proportional gain to determine a second value;

summing the first value and the second value; and

generating an updated speed control command based on the sum of the first value and the second value.

10. The method of claim 9 and further comprising measuring the actual pressure between the pump and a water tank.

11. The method of claim 9 and further comprising generating an updated speed control command that includes a pulse-width modulated signal.

12. The method of claim 9 and further comprising generating an updated speed control command that includes a space vector pulse-width modulated signal.

13. The method of claim 9 and further comprising generating the updated speed control command in real-time.

14. The method of claim 9 and further comprising generating an updated speed control command that includes a motor drive frequency.

15. The method of claim 9 and further comprising determining whether the actual pressure is greater than a high band pressure or less than a low band pressure.

16. The method of claim 15 and further comprising generating an updated speed control command when the actual pressure is less than the low band pressure.

17. The method of claim 15 and further comprising generating an updated speed control command until the actual pressure is greater than the high band pressure.

18. The method of claim 9 and further comprising generating a motor command including the updated speed control command and a minimum calibrated speed value.

19. The method of claim 9 and further comprising measuring an actual pressure in a water distribution system connected to at least one of a well pump system, a municipal water system, a pool system, a spa system, a recreational vehicle water system, a marine craft water system, a turf or irrigation system, and a pressure booster system.

20. A method of operating a motor of a pump, the method comprising:

measuring a bus current being provided to the motor;

determining whether the bus current is greater than a limp current limit setting;

reducing at least one of an output voltage provided to the motor and an operating frequency of the motor if the bus current is greater than the limp current limit setting in order to drive the motor in a limp mode; and

shutting down the motor if the motor does not operate within operational limits while being driven in the limp mode.

21. The method of claim 20 and further comprising driving the motor in the limp mode without generating a fault condition code.

22. The method of claim 21 and further comprising generating the fault condition code while shutting down the motor.

23. The method of claim 20 and further comprising indicating to a user that the motor is operating in the limp mode.

24. A method of operating a motor of a pump, the method comprising:

measuring a bus voltage being provided to the motor;

determining whether the bus voltage is less than a programmed threshold;

reducing at least one of an output voltage provided to the motor and an operating frequency of the motor if the bus voltage is less than the programmed threshold in order to drive the motor in a limp mode; and

shutting down the motor if the motor does not operate within operational limits while being driven in the limp mode.

25. The method of claim 24 and further comprising driving the motor in the limp mode without generating a fault condition code.

26. The method of claim 25 and further comprising generating the fault condition code while shutting down the motor.

27. The method of claim 24 and further comprising indicating to a user that the motor is operating in the limp mode.

28. A method of operating a motor of a pump, the method comprising:

measuring a line current;

determining whether the line current is greater than a programmed threshold;

reducing at least one of an output voltage provided to the motor and an operating frequency of the motor if the line current is less than the programmed threshold in order to drive the motor in a limp mode; and

shutting down the motor if the motor does not operate within operational limits while being driven in the limp mode.

29. The method of claim 28 and further comprising driving the motor in the limp mode without generating a fault condition code.

30. The method of claim 29 and further comprising generating the fault condition code while shutting down the motor.

31. The method of claim 28 and further comprising indicating to a user that the motor is operating in the limp mode.

32. A method of operating a motor of a pump, the method comprising:

measuring a temperature of a heat sink;

determining whether the temperature is greater than a limp temperature limit setting;

reducing at least one of an output voltage provided to the motor and an operating frequency of the motor if the temperature is greater than the limp temperature limit setting in order to drive the motor in a limp mode; and

shutting down the motor if the motor does not operate within operational limits while being driven in the limp mode.

33. The method of claim 32 and further comprising driving the motor in the limp mode without generating a fault condition code.

34. The method of claim 33 and further comprising generating the fault condition code while shutting down the motor.

35. The method of claim 32 and further comprising indicating to a user that the motor is operating in the limp mode.

36. A method of detecting a fault condition in a motor of a pump, the method comprising:

measuring a bus voltage being provided to the motor;

generating a fault condition code if the bus voltage is greater than an upper limit or less than a lower limit;

shutting down a drive to the motor for a time period; and

restarting the drive to the motor after the time period has elapsed.

37. The method of claim 36 and further comprising generating a fault condition code if the bus voltage is greater than about 450 volts or less than about 250 volts.

38. The method of claim 36 and further comprising shutting down a drive to the motor for about 30 seconds.

39. The method of claim 36 and further comprising indicating to a user that a fault condition code has been generated.

40. A method of detecting a fault condition in a motor of a pump, the method comprising:

measuring a bus current being provided to the motor;

generating a fault condition code if the bus current is greater than a bus current upper limit setting;

shutting down a drive to the motor for a time period; and

restarting the drive to the motor after the time period has elapsed.

41. The method of claim 40 and further comprising generating a fault condition code if the bus current is greater than about 25 amps.

42. The method of claim 40 and further comprising shutting down a drive to the motor for about 30 seconds.

43. The method of claim 40 and further comprising indicating to a user that a fault condition code has been generated.

44. A method of detecting a fault condition in a motor of a pump, the method comprising:

sensing a first bus current value;

starting a timer if the first bus current value is less than a pre-set threshold;

sensing a second bus current value after a pre-set time period has elapsed;

determining whether a drive to the motor is operating at a full speed;

generating a fault condition code if the second bus current value is also less than the pre-set threshold and if the drive to the motor is operating at the full speed;

shutting down the drive to the motor for a time period; and

restarting the drive to the motor after the time period has elapsed.

45. The method of claim 44 and further comprising sensing a second bus current value after a about one second has elapsed.

46. The method of claim 44 and further comprising generating a fault condition code if the second bus current value is less than about 1.5 amps and if the drive to the motor is operating at the full speed.

47. The method of claim 44 and further comprising shutting down a drive to the motor for about 30 seconds.

48. The method of claim 44 and further comprising indicating to a user that a fault condition code has been generated.

49. A method of detecting a fault condition in a motor of a pump, the method comprising:

sensing a first temperature value of a heat sink;

generating a fault condition code if the first temperature value is greater than a temperature upper limit;

shutting down a drive to the motor;

sensing a second temperature value of the heat sink; and

attempting to restart the drive to the motor if the second temperature value is less than a limp mode temperature limit.

50. The method of claim 49 and further comprising sensing a first temperature of a heat sink connected to at least one of the pump, the motor, and a controller.

51. The method of claim 49 and further comprising generating a fault condition code if the first temperature value is greater than about 70 degrees Celsius.

52. The method of claim 49 and further comprising attempting to restart the drive to the motor if the second temperature value is less than about 60 degrees Celsius.

53. The method of claim 49 and further comprising indicating to a user that a fault condition code has been generated.

54. The method of claim 49 and further comprising setting the limp mode temperature limit based on an input voltage.

55. A method of detecting a fault condition in a motor of a pump, the method comprising:

sensing a first bus current value;

sensing a speed of the motor;

incrementing a counter and setting a timer if the first bus current value is greater than a bus current upper limit and if the speed of the motor is greater than or equal to a high speed limit;

attempting to operate the motor in a reverse direction if the counter has been incremented above an increment limit within a first time period;

sensing a second bus current value while the motor is operating in the reverse direction;

operating the motor in the reverse direction for a second time period if the second bus current value is less than the bus current upper limit and attempting to operate the motor in a forward direction once the second time period has elapsed; and

generating a fault condition code and shutting down a drive to the motor if the second bus current value is greater than the bus current upper limit.

56. The method of claim 55 and further comprising incrementing a counter and setting a timer if the first bus current value is greater than about 15 amps and if the speed of the motor is greater than or equal to a high speed limit.

57. The method of claim 55 and further comprising attempting to operate the motor in a reverse direction if the counter has been incremented above five increments within about five minutes.

58. The method of claim 55 and further comprising operating the motor in the reverse direction for about 30 seconds.

59. The method of claim 55 and further comprising indicating to a user that a fault condition code has been generated.

60. A method of detecting a fault condition in a motor of a pump, the method comprising:

sensing a first line current value;

sensing a speed of the motor;

attempting to operate the motor in a reverse direction if the first line current value is greater than a programmed threshold and if the speed of the motor is less than a motor speed low threshold;

sensing a second line current value while the motor is operating in the reverse direction;

generating a fault condition code and shutting down a drive to the motor if the second line current value is also greater than the programmed threshold; and

operating the motor in the reverse direction for a time period if the second line current value is less than the programmed threshold and attempting to operate the motor in a forward direction after the time period has elapsed.

61. The method of claim 60 and further comprising generating a fault condition code and shutting down a drive to the motor if the second line current value is greater than about 7 amps.

62. The method of claim 60 and further comprising operating the motor in the reverse direction for about 30 seconds.

63. The method of claim 60 and further comprising indicating to a user that a fault condition code has been generated.

64. A method of detecting a pressure sensor failure in a water distribution system, the water distribution system connected to a pump with a motor, the method comprising:

detecting a first pressure sensor signal;

shutting down a drive to the motor if the pressure sensor signal is outside of a sense range;

attempting to detect a second pressure sensor signal after power has be reapplied to the drive; and

allowing the drive to remain shut down until a second pressure signal is detected.

65. The method of claim 64 and further comprising shutting down a drive to the motor if the pressure sensor signal is outside of a sense range of about 25 to about 95 pounds per square inch.

66. The method of claim 64 and further comprising generating a fault condition code while shutting down the drive to the motor.

67. The method of claim 66 and further comprising indicating to a user that a fault condition code has been generated.

68. The method of claim 64 and further comprising automatically detecting a type of pressure sensor that is generating at least one of the first pressure sensor signal and the second pressure sensor.

69. A method of operating a pressure sensor in a water distribution system, the water distribution system connected to a pump with a motor, the method comprising:

detecting a pressure sensor signal;

disabling a power supply connected to the pressure sensor if the pressure sensor signal indicates that the power supply is shorted; and

generating a fault condition code and shutting down a drive to the motor if the shorted power supply is a selected sensor input for the pressure sensor.

70. The method of claim 69 and further comprising automatically detecting a type of pressure sensor that is generating the pressure sensor signal.

71. The method of claim 69 and further comprising indicating to a user that a fault condition code has been generated.

72. A method of monitoring fault conditions occurring in a water distribution system, the method comprising:

sensing a new fault condition occurring in the water distribution system;

generating a fault condition code and incrementing a counter;

determining whether the counter has been incremented above an increment limit;

storing the new fault condition code over one of a plurality of old fault condition codes if the counter has been incremented above an increment limit;

storing the new fault condition code in a new memory location if the counter has not been incremented above an increment limit; and

retrieving the new fault condition code and the plurality of old fault condition codes.

73. The method of claim 72 and further comprising determining whether the counter has been incremented above an increment limit of 15 fault condition codes.

74. The method of claim 72 and further comprising storing the new fault condition code over an oldest one of the plurality of old fault condition codes if the counter has been incremented above the increment limit.

75. The method of claim 72 and further comprising retrieving the new fault condition code and the plurality of old fault condition codes with at least one of a serial communication link and a wireless communication link.

76. The method of claim 72 and further comprising indicating to a user a type of fault condition code of the new fault condition code.

77. A pump control system for use with a pump in one of a pool system and a spa system, the pump control system comprising:

a controller connected to a motor of the pump; and

a switch connected to the controller, the switch being connected to at least one of a guard and a grate in one of the pool system and the spa system, the switch providing a run/stop input when at least one of the guard and the grate are removed, the run/stop input causing the controller to automatically disable the motor.

78. The pump control system of claim 77, wherein the controller includes a digital signal processor and a microcontroller that communicates with the digital signal processor, the microcontroller receiving the run/stop input.

79. The pump control system of claim 77, wherein the switch is a first switch, and further comprising a second switch connected to the first switch in a daisy chain configuration, the controller automatically disabling the motor if either the first switch or the second switch provides a run/stop input.

80. A pump controller for use with a pump having a motor, the pump connected to a water distribution system, the pump controller comprising:

a digital signal processor, the digital signal processor programmed to perform a self-calibration procedure, to operate the motor in a limp mode, and to detect fault conditions in the water distribution system; and

a microcontroller that communicates with the digital signal processor, the microcontroller programmed to receive inputs from sensors in the water distribution system and to coordinate serial communications.

81. A pump controller for use with a pump having a motor, the pump controller connected to an AC bus line, the pump controller comprising:

an internal fuse removably connected to the AC bus line, the internal fuse being replaceable in order to configure the pump controller for operation with one of a single-phase 115 volt input and a single-phase 230 volt input from the AC bus line; and

a digital signal processor connected to the internal fuse, the digital signal processor programmed to control three-phase output power provided to the motor from one of the single-phase 115 volt input and the single-phase 230 volt input.

82. The pump controller of claim 81, wherein the digital signal processor controls three-phase output power provided to the motor using pulse-width modulation.

83. A pump system connected to a water distribution system, the pump system comprising:

a pump having a motor, the motor operating according to one of a plurality of Voltage/Hertz curves; and

a controller connected to the motor, the controller being programmable by a user to operate the motor according to the one of the plurality of Voltage/Hertz curves.

84. The pump system of claim 83, wherein the controller is programmable by a user via a serial communication link.

85. The pump system of claim 83, wherein the controller is programmable according to at least one default Voltage/Hertz curve and at least one custom Voltage/Hertz curve.

86. The pump system of claim 83, and further comprising a terminal including a motor select switch that can be actuated by a user to program the controller to operate according to one of the plurality of Voltage/Hertz curves.